

IN THE CLAIMS

We claim:

- ~~1. A method of forming an oxide film including:
placing a substrate in a deposition chamber;
decomposing a silicon source gas and an oxidation source gas using a thermal
energy source in said deposition chamber; and
forming a silicon oxide film above said substrate wherein a total pressure for
said deposition chamber is maintained in the range of 50 to 350 Torr during
deposition process.~~
- ~~2. A method as in claim 1 wherein said silicon source gas is selected from a group
consisting of silane, disilane, methylsilane, and halogenated silanes.~~
- ~~3. A method as in claim 1 further including mixing said silicon source gas with said
oxidation source gas prior to said decomposing.~~
- ~~4. A method as in claim 1 wherein said oxidation source gas is selected from a group
consisting of nitrous oxide, ozone, and tetraethoxysilane (TEOS).~~
- ~~5. A method of forming an oxide film including:
placing a substrate in a deposition chamber;
decomposing a silicon source gas and an oxidation source gas using a thermal
energy source in said deposition chamber; and
forming a silicon oxide film above said substrate in said deposition chamber
wherein a flow ratio for said silicon source gas and said oxidation source gas is in the
range of 1:50 to 1:10000.~~
- ~~6. A method as in claim 5 wherein said silicon source gas is selected from a group
consisting of silane, disilane, methylsilane, and halogenated silanes.~~

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7. A method as in claim 5 further including reacting said silicon source gas with said oxidation source gas prior to said decomposing.
8. A method as in claim 5 wherein said oxidation source gas is selected from a group consisting of nitrous oxide, ozone, and TEOS.
9. A method of forming an oxide film including:
placing a substrate in a deposition chamber;
decomposing a silicon source gas and an oxidation source gas using a thermal energy source in said deposition chamber;
forming a silicon oxide film above said substrate in said deposition chamber;
and
annealing said substrate using a thermal annealing process.
10. A method as in claim 9 wherein same source gases as said silicon source gas and said oxidation source gas are used for said thermal annealing process.
11. A method as in claim 9 wherein said silicon source gas is selected from a group consisting of silane, disilane, methylsilane, and halogenated silanes.
12. A method as in claim 9 further including mixing said silicon source gas with said oxidation source gas prior to said decomposing.
13. A method as in claim 9 wherein said oxidation source gas is selected from a group consisting of nitrous oxide, ozone, and TEOS.
14. A method of forming an oxide film including:
placing a substrate in a deposition chamber;
decomposing a silicon source gas and an oxidation source gas using a thermal energy source in said deposition chamber;

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forming a silicon oxide film above said substrate in said deposition chamber, wherein a total pressure for said deposition chamber is maintained in the range of 50 to 350 Torr and wherein a ratio for said silicon source gas and said oxidation source gas is in the range of 1:50 to 1:10000 during deposition process; and annealing said substrate using a thermal annealing process.

15. A method as in claim 14 wherein same source gases as said silicon source gas and said oxidation source gas are used for said thermal annealing process.
16. A method as in claim 14 wherein said silicon source gas is selected from a group of consisting of silane, disilane, methylsilane, and halogenated silanes.
17. A method as in claim 14 further including mixing said silicon source gas with said oxidation source gas prior to said decomposing.
18. A method as in claim 14 wherein said oxidation source gas is any one of nitrous oxide, ozone, and TEOS.
19. A method of forming a silicon oxynitride film including:
 - placing a substrate in a deposition chamber and obtaining a desired process temperature and a desired process pressure;
 - flowing an oxidation source gas into said deposition chamber at a first desired flow rate for a first predetermined amount of time after said desired process temperature and said desired process pressure are obtained;
 - diverting a silicon source gas away from said deposition chamber, said diverting having said silicon source gas flows at a second desired flow rate and said diverting occurring before forming said silicon oxynitride film;
 - stopping said diverting and flowing said silicon source gas at said second desired flow rate into said deposition chamber;
 - decomposing said silicon source gas and said oxidation source gas in said deposition chamber using a thermal energy source;

forming said silicon oxynitride film above said substrate wherein said desired process pressure is between of 50 to 350 Torr, wherein said desired process temperature is between 400°C to 800°C, and wherein a flow ratio for said silicon source gas and said oxidation source gas is between 1:50 to 1:10000;

wherein said silicon source gas is mixed with a nitridation source gas; terminating said silicon source gas into said deposition chamber while maintaining said flowing of said oxidation source gas in said deposition chamber for a second predetermined amount of time; and

purging said deposition chamber with a cleaning gas.

20. A method as in claim 19 wherein said silicon source gas is selected from a group consisting of silane, disilane, methylsilane, and halogenated silanes.
21. A method as in claim 19 further including mixing said silicon source gas with said oxidation source gas prior to said forming of said silicon oxynitride film.
22. A method as in claim 19 wherein said oxidation source gas is selected from a group consisting of nitrous oxide, ozone, and TEOS.
23. A method as in claim 19 wherein said nitrogen source gas is selected from a group consisting of an ammonium source gas, ammonia, and hydrazine.
24. An oxide film having a thickness between 10Å to 3000Å and a growth rate between 20Å per minute and 2000Å per minute, wherein said oxide film is formed by a thermal low-pressure chemical vapor deposition in a cold wall reactor, wherein a silicon source gas and an oxidation source gas are decomposed by a thermal energy source in said reactor to form said oxide film, wherein a flow ratio for said silicon source gas and said oxidation source gas is between 1:50 to 1:10000, and wherein a total pressure in said reactor is between 50 Torr to 350 Torr during forming process of said oxide film.

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25. A process of forming an oxide film including:

depositing a substrate in a deposition chamber, said deposition chamber designed such that thermal low-pressure chemical vapor deposition process is utilized to form said oxide film on said substrate

said deposition chamber further includes a water passage to create a cold wall deposition chamber, a resistively heated heater pocket to heat up said substrate wherein said substrate is horizontally placed on said heater pocket and a gas distribution point for injection reactant gases into said deposition chamber;

flowing a silicon source gas and an oxidation source gas into said distribution point wherein said distribution point is located above said resistively heated heater pocket;

decomposing said silicon source gas and said oxidation source gas using a thermal energy source from said deposition chamber; and

forming said oxide film on said substrate.

26. A substrate processing system including:

a substrate holder, located within a chamber, said substrate holder holds a substrate during substrate processing;

a gas delivery system for introducing a reactant gas mixture into said chamber to deposit an silicon oxide film over said substrate, said reactant gas including a silicon source gas, a carrier gas mixed for carrying said silicon source gas, and an oxidation source gas;

a pump coupled to a gas outlet for controlling pressure in said chamber;

a controller for controlling said gas delivery system and said pump; and

a memory coupled to said controller comprising a computer-readable medium having a computer readable program embodied therein for directing operation of said substrate processing system, said computer-readable program including:

instructions for controlling said gas delivery system to introduce said reactant gas mixture into said chamber to deposit said silicon oxide film over said substrate positioned on said substrate holder, said instruction introducing said reactant gas

mixture such that said reactant gas mixture has a flow ratio between 1:50 to 1:10000 of said silicon source gas to said oxidation source gas.

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27. A substrate processing system including:

a substrate holder, located within a chamber, said substrate holder holds a substrate during substrate processing, said chamber being a cold-wall chamber and enabling a thermal low pressure chemical vapor deposition process;

a gas delivery system for introducing a reactant gas mixture into said chamber to deposit an silicon oxide film over said substrate, said reactant gas including a silicon source gas, a carrier gas mixed for carrying said silicon source gas, and an oxidation source gas;

a pump coupled to a gas outlet for controlling pressure in said chamber;

a controller for controlling said gas delivery system and said pump; and

a memory coupled to said controller comprising a computer-readable medium having a computer readable program embodied therein for directing operation of said thermal low-pressure chemical vapor deposition process, said computer-readable program including:

instructions for controlling said gas delivery system to introduce said reactant gas mixture into said chamber to deposit said silicon oxide film over said substrate positioned on said substrate holder, said instruction introducing said reactant gas mixture such that said reactant gas mixture has a flow ratio between 1:50 to 1:10000 of said silicon source gas to said oxidation source gas.